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AUTHOR Haury, David L.

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ABSTRACT

This digest provides a guide to improving student achievement in mathematics education and suggests resources for further study. It provides recommendations for the classroom and is a companion piece to "Improving Student Achievement in Mathematics, Part I: Research Findings." Recommendations include that students can learn both concepts and skills by solving problems, whole-class discussion following individual and group work improves student achievement, and using calculators in the learning of mathematics can result in increased achievement and improved student attitudes. A brief annotated bibliography and sections on "Finding Resources in the ERIC Database," and "Searching the Web for Additional Resources" are also included. (Contains 13 references.) (MM)

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By

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Literature-Based Mathematics in Elementary School

David L. Haury

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DIGEST

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Clearinghouse for Science, Mathematics, and Environmental Education

When we think of mathematics books, we think of non-fiction, even though mathematics itself is predominantly fiction (Pappas, 1999).

Some of us may feel uncomfortable with the notion that mathematics is fiction, but the concepts and procedures of mathematics are all constructions of our minds, products of our attempts to understand our worlds, real and imaginary. Some mathematical ideas have obvious practical applications in our everyday lives, while other ideas seem very abstract, with little apparent connection to life as most of us experience it. All mathematical ideas, though, take shape through our attempts to communicate, and therefore find their way into our literature. Having an inherent sense of number (Dehaene, 1997), we express mathematical ideas in stories, essays, poems, books, and other forms of literature that convey life experiences, real or imagined. One way of connecting school mathematics to everyday life, then, is to draw attention to the mathematics embedded in the literature of everyday life, to reveal the mathematics inherent in human thinking and communication about life experiences.

Benefits of the Literature Connection

Linking mathematics instruction to children's literature has become increasingly popular in recent years for a variety of reasons. Some suggest that the literature connection motivates students (Usnick & McCarthy, 1998), provokes interest (Welchman-Tischler, 1992), helps students connect mathematical ideas to their personal experiences (Murphy, 2000), accommodates children with different learning styles (Murphy, 2000), promotes critical thinking (Murphy, 2000), or provides a context for using mathematics to solve problems (Jacobs & Rak, 1997; Melser & Leitze, 1999). Hebert and Furner (1997) introduced the idea of "bibliotherapy" to help students see mathematics as a tool for making life easier. Smith (1999) described the use of literature in designing lessons that place mathematical ideas in a cultural context.

Despite the many suggestions and reasons for incorporating literature into mathematics instruction, however, relatively few formal studies of the benefits of literature-based mathematics have been reported. Hong (1996) did find that kindergartners exposed to story-related mathematics exhibited a greater preference and aptitude for mathematics activities than did those of a comparison group. Whitin and Whitin (2000) explored the ways in which fourth-grade students use story, metaphor, and language to develop mathematical thinking skills and strategies, and their book offers ideas for using children's literature to inspire mathematical investigations and to teach mathematical concepts. Another research group (Karp, Brown, Allen, & Allen, 1998) examined the use of role models in children's literature to promote conceptual understanding and passion for mathematics among girls. In each of these studies, the value of literature-based mathematics instruction seems to be affirmed, but in what ways can literature be incorporated into mathematics instruction?

Ways to Use Children's Literature in Teaching Mathematics

Though many children's books are explicitly about mathematics, such as books about counting or shapes, other books have mathematics embedded within a larger context. These books are generally not perceived as "math books," but mathematics appears as a natural element within stories, problems, personal vignettes, or cultural events. Welchman-Tischler (1992) has classified the ways to use such books as follows:

1. To provide a context or model for an activity with mathematical content.
2. To introduce manipulatives that will be used in varied ways (not necessarily as in the story).
3. To inspire a creative mathematics experience for children.
4. To pose an interesting problem.
5. To prepare for a mathematics concept or skill.
6. To develop or explain a mathematics concept or skill.
7. To review a mathematics concept or skill.

Though any given book could likely be used in multiple ways, the common element in these various approaches is the intent to use literature to provide vicarious mathematical experiences based on real problems or situations of interest to teachers and students.

The Importance of Context

Criteria for evaluating children's books with mathematical dimensions have been offered by Austin (1998), and she makes the point that books to be used should provide a pleasurable and authentic literary experience as well as the opportunity to use mathematics for authentic purposes. Context is key. Without context, whether through direct experiences with objects, everyday problems to solve, or literature-based mathematics, schoolroom mathematics too easily becomes reduced to what Carl Sandbug described in his poem, *Arithmetic*: "Arithmetic is numbers you squeeze from your head to your hand to your pencil to your paper till you get the answer." Through attention to the mathematics in literature, we can help students realize that mathematics, including arithmetic, is a spontaneous and natural expression of human minds attempting to capture important aspects of our experienced and imagined worlds.

References

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Smith,N. L., Babione, C., & Vick, B. J. (1999). Dumpling soup: Exploring kitchens, cultures, and mathematics. Teaching Children Mathematics, 6 (3), 148-52. [EJ 597 952]

Usnick, V. & McCarthy,J. (1998). Turning adolescents onto mathematics through literature. *Middle School Journal, 29* (4), 50-54. [EJ 615 455]

Welchman-Tischler, R. (1992). How to use children's literature to teach mathematics. Reston, VA: National Council of Teachers of Mathematics. Available online at http://watt.enc.org/online/ENC2285/2285.html.

Whitin, P. & Whitin,D. J. (2000). Mathematics is language too: Talking and writing in the mathematics classroom. Urbana, IL and Reston VA: National Council of Teachers of English, National Council of Teachers of Mathematics. [ED 438 537]

Resources

Thiessen, D., Matthias, M., & Smith, J. (1998). *The wonderful world of mathematics: A critically annotated list of children's books in mathematics*. 2nd Edition. Reston, VA: National Council of Teachers of Mathematics. [ED 419 691]

This book provides annotated bibliographies of children's literature books emphasizing mathematics education. Each review describes the book's content and accuracy, its illustrations and their appropriateness, the author's writing style, and indicates whether activities for the reader are included. Chapters in this book include: (1) Early Number Concepts; (2) Number-Extensions and Connections; (3) Measurement; (4) Geometry and Spatial Sense; and (5) Series and Other Resources.

NCTM Illuminations:

http://illuminations.nctm.org/index2.html

Use the search engine provided by this Web site to find standards, readings, and activities related to integrating mathematics and literature at all grade levels.

Focus on Using Children's Literature in Math and Science

http://www.enc.org/focus/lit/

This is an online version of a magazine produced by the Eisenhower National Clearinghouse for Mathematics and Science Education.

Children's Literature in the Mathematics Classroom

http://Indiana.edu/~eric_rec/ieo/bibs/childmat.html

An extensive directory of online and printed resources, including a listing of citations from the ERIC database.

The Literature-Math Connection

http://www.abcteach.com/Math/mathTOC.htm

A listing of children's books that relate to counting, estimating, fractions, geometry, graphing, measurement, money, number relationships, pattern, probability, sorting, and time.

Carol Hurst's Children's Literature Site

http://www.carolhurst.com/

In addition to reviews of books, this Web site offers activities and ideas for using children's literature in many subject areas, including mathematics.

Finding Resources in the ERIC Database

Many relevant materials are described in the ERIC database, available online at: http://ericir.syr.edu/Eric/adv_search.shtml. To search the database most effectively, use combinations of ERIC Descriptors. As of September 2001, there were 213 items indexed by the Descriptors *mathematics* and *childrens literature*. For more tailored searches, combine these terms with one or more of the following Descriptors: *arithmetic, algebra, computation, estimation mathematics, geometry, mathematical concepts, mathematics skills, numbers, patterns in mathematics, probability, problem solving, statistics*, or *word problems mathematics*. To search for resources appropriate for a particular grade level, include one or more of the following ERIC Descriptors: *early childhood education, primary education, preschool education, elementary education, secondary education, elementary secondary education, intermediate grades, middle schools*, or *junior high schools*. For greater specificity, use one or more of the following ERIC Descriptors: *kindergarten, grade 1, grade 2*, etc.

Searching the Web for Additional Resources

To find other relevant materials on the World Wide Web, use a search engine such as Google (http://www.google.com) and search terms such as: math OR mathematics teaching OR teach literature.

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